GREAT LAKES LEGACY ACT SEDIMENT REMEDIATION RESEARCH ON *IN SITU* TREATMENT

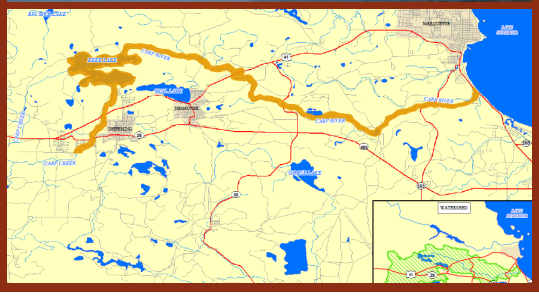
Deer Lake

Introduction

This fact sheet is one of a series produced by the Great Lakes Legacy Act (GLLA) research effort between the U.S. EPA Office of Research and Development (EPA ORD) and the USACE Engineer Research and Development Center (ERDC).

To help support remediation and restoration efforts at Great Lakes Areas of Concern, this report provides a brief summary of the potential for *in situ* remedial actions for Deer Lake.

Great Lakes contaminated sediment sites contain elevated concentrations of contaminants of concern (COCs), such as metals and hydrophobic organic compounds. *In situ* management of the contaminants via containment or sediment treatment holds significant advantages over removal and *ex situ* treatment and disposal.



Deer Lake is a 100-acre impoundment located near Ishpeming, Michigan. This lake was classified as an area of concern (AOC) due to two known industrial sources of mercury that caused elevated mercury concentrations in Deer Lake sediments and fish, requiring fish consumption advisories. There are also high nutrient levels in the lake leading to it being characterized as hypereutrophic (excessively nutrient-rich). The combination of mercury in sediments and high nutrient levels can enhance sulfate reduction processes in sediments that promote the formation of methyl mercury, which is highly bioaccumulative in fish. Both mercury and methyl mercury are contaminants of concern in the lake.

In situ management of mercury and methyl mercury can be accomplished by reducing the availability of mercury or by directly reducing the process of methylation or subsequent mobilization of methyl mercury. Amendments that achieve one or both goals could be introduced into surficial sediments or into sediment capping materials placed on top of the sediments. Potential amendments that can achieve one or both goals include activated carbon, organophilic clays, and more exotic materials, including Thiol-SAMMS (THSL-62), MERSORB (sulfur impregnated coal-based activated carbon), fused sticks of ferrous sulfide (FeS), and Zeolite.

The analysis of sediment *in situ* remediation options such as capping or *in situ* treatment with amendments depend upon accurately determining sediment pore water characteristics. Sediment biogeochemistry can affect contaminant speciation and fate; natural organic matter may affect amendment performance. Natural organic matter and sediment biogeo-chemistry can also interfere with the measurement of contaminants in the interstitial water and passive sampling is often required to accurately measure the mobile and available contaminants in the interstitial water. It is for these reasons that site-specific studies were undertaken.

Experimental Studies

Figure 1. Pancake Column setup

- For the Deer Lake site, the effectiveness of different amendments was determined by conducting a series of thin-layer column tests. These column tests generally follow the procedures of the Pancake Column Leach Test (PCLT).
- The PCLT serves as a laboratory-scale physical model of contaminant elution from dredged material that includes advection-dispersion and other mass transfer effects.
- Batch sorption tests were also conducted, although for some materials mercury sorption estimates were provided by the manufacturer. Mercury is often associated with different complexes; for example, organic complexes or sulfides, that if present, influence sorption behavior.
- The amendments were mixed into the sediment and pore water from the site was pumped through the PCLT columns. The evaluated amendments include Thiol-SAMMS (THSL-62), MERSORB (sulfur impregnated coal-based activated carbon), fused sticks of ferrous sulfide (FeS), conventional activated carbon, organophilic clays (both mercury sorbing and conventional) and Zeolite.
- The addition of Zeolite to the sediment appears to greatly reduce the production of MeHg in the sediment and does not appear to initially exacerbate the flux of MeHg to the pore water.
- The addition of Thiol-SAMMS to the sediment appears to not only limit the flux of MeHg to the pore water, but also remove almost all soluble non-particulate Hg from the pore water. Its ability to remove soluble Hg from the pore water appears to decrease after sufficient loading, but its ability to limit MeHg flux to the pore water appears to increase with time.

Remedy Evaluation

- Both Zeolite and Thiol-SAMMS appear to be good candidates for limiting the bioavailability of mercury in sediment by limiting the presence of MeHg. Other materials also showed some promise but with reduced effectiveness.
- It is suggested that incorporation of these amendments to Sedimite® may be a practical method of incorporating them into mercury contaminated sediments.
- A cap amended with any of these two materials could effectively eliminate methyl mercury flux to the surface.

Potential Remedial Implementation based on Laboratory

- An amended cap of Zeolite or Thiol-SAMMS mixed with sand or mixed with GAC would reduce mercury bioavailability and methyl mercury production based on the experimental results.

For Further Information

- **http://epa.gov/greatlakes/aoc/torchlake/index.html**
- **http://www.erdc.usace.army.mil/**
- **http://www.epa.gov/nrmrl/**

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